

# Hardware Commissioning of the LHC: a perspective from CERN

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- Roles
- Sequence and Procedures
- Involvement of US labs

# Roles

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“Hardware commissioning is the responsibility of all those commissioning the sector as a whole, namely, the members of the Hardware Commissioning Working Team, the Groups owning the equipment and the operators from the Accelerator Control Room.” (R. Saban)

Approach and organization draws heavily from the experience of commissioning and running of the LHC Strings.

# Procedure

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- Equipment owner groups define the Individual System Tests after installation, and are responsible for the definition of test plans, prerequisites and qualification criteria.
- Hardware commissioning refers to commissioning of the sectors or parts of the sector (e.g. continuous arc cryostat, inner triplet subsector, individually powered quadrupoles) as a single system. Conditions (prerequisites, procedures, sequence) for HC are defined ahead by the Hardware Commissioning Working Group, organized in analogy to String 2.
- Hardware commissioning performed by HC Working Team, (field incarnation of HCWG including operators).

# Sequence

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- Individual systems tests performed on: magnets, cryogenics, electrical feedboxes and power circuits, vacuum, quench protection and interlocks.
- Some of the equipment cooled and operated for the first time during hardware commissioning (e.g. DFBX).
- “Hardware commissioning of a sector is considered finished when all circuits are powered to nominal current independently and in a pattern representative of LHC operation.” (R. Saban)

# Comments concerning involvement of US labs

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- Fermilab, BNL and LBL are systems designers and builders but not formally an “owner group”.  
(The responsibility of US-LHC ends with the acceptance in CERN of the equipment delivered. Part of the equipment is supplied by other labs ...)
- Systems supplied by US-LHC can be commissioned separately (inner triplet, Q4-D2 string), and are quite different from the LHC arc string.
- Important data obtained during magnet tests are not part of acceptance documents, but should be available for commissioning.

# Preparation for commissioning of the inner triplet

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- HCWG reviewed procedures for individual system tests and hardware commissioning of the inner triplet in in July-August 03.
- HCWG conclusion:
  - Equipment groups are cognizant of the equipment. With the experience of running the String and the Fermilab cooling cell, hardware commissioning of the triplet can be performed.
  - Effective commissioning would profit from the presence of US labs.

# Some questions concerning US participation

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- Assistance of US project engineers in installation of the triplet is very desirable (“dry” assembly of the triplet on the ground; assembly of a first few triplets).
- Are all labs interested in HC of their equipment?
- If a lab does not take part in HC, will other labs take over?
- Is there a mechanism by which test data is available for HC?
- Inner triplet is a “closed system”. Will US labs take part in commissioning of the system as a whole, including equipment supplied by KEK and CERN?
- Is there a plan for commissioning of the DFBX?